

NON-PUBLIC?: N
ACCESSION #: 8807290082
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Salem Generating Station - Unit 2 PAGE: 1 of 5

DOCKET NUMBER: 05000311

TITLE: Reactor Trip/Safety Injection Due To Failure Of The C Vital
Instrument Bus Inverter
EVENT DATE: 06/22/88 LER #: 88-014-00 REPORT DATE: 07/20/88

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: M. J. Pollack, LER Coordinator TELEPHONE #: 609-339-4022

COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: EE COMPONENT: INVT MANUFACTURER: G037
REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On 6/22/88, during routine power operation, a reactor trip and safety injection (SI) occurred. The reactor trip occurred when the Solid State Protection System (SSPS) (JC) sensed No. 23 reactor coolant pump (RCP) breaker open. A reactor trip will occur when one of the four RCP breakers opens with power above P-8 (36%). The SI was the result of a combination of the indication of Nos. 22 and 23 Steamline Low Pressure (less than 500 psig) and Nos. 21 and 22 High Steamline Flow. The Unit was stabilized in Mode 3 (Hot Standby). The apparent root cause of this event has been attributed to the failure of the "C" Vital Instrument Bus inverter. Valve 2PR2 and the Nos. 23 and 2

CFCUs (which failed to function as designed during the event) were tested to ensure operability. No problems were identified. The "C" Vital Instrument Bus Inverter was repaired. The Unit was returned to service on June 25, 1988. A design change has been initiated (2EC-2245) to delete the reactor trip logic which occurs when "one out of four RCP breakers open" is met. This design change will be implemented during the upcoming fourth refueling outage pending approval by the NRC of a submitted license change request. A similar

design change for Salem Unit 1 will be implemented during its next refueling outage. A design change is being prepared to replace the inverters with state of the art equipment.

(End of Abstract)

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PLANT AND SYSTEM IDENTIFICATION:

Westinghouse - Pressurized Water Reactor

Energy Industry Identification System (EIIS) codes are identified in the text as (xx)

IDENTIFICATION OF OCCURRENCE:

Reactor Trip/Safety Injection From 100% Power Due To Failure of the "C" Vital Instrument Bus Inverter

Event Date: 6/22/88

Report Date: 7/20/88

This report was initiated by Incident Report No. 88-242.

CONDITIONS PRIOR TO OCCURRENCE:

Mode 1 Reactor Power 100% - Unit Load 1140 MWe

DESCRIPTION OF OCCURRENCE:

On June 22, 1988 at 1042 hours, during routine power operation, a reactor trip and safety injection (SI) occurred. The reactor trip occurred when the Solid State Protection System (SSPS) (JC) sensed No. 23 reactor coolant pump (RCP) breaker open. A reactor trip will occur when one of the four RCP breakers opens with power above P-8 (36%). The SI was the result of a combination of the indication of Nos. 22 and 23 Steamline Low Pressure (less than 500 psig) and Nos. 21 and 22 High Steamline Flow. This was the ninth SI actuation cycle to date.

The Unit was stabilized in Mode 3 (Hot Standby), and in accordance with the requirements of the Code of Federal Regulations 10CFR 50.72(b)(2)(ii), the Nuclear Regulatory Commission was notified of the automatic actuation of the Reactor Protection System (JC) and the automatic actuation of the Emergency Core Cooling System (JE).

APPARENT CAUSE OF OCCURRENCE:

The apparent root cause of this event has been attributed to the failure of the "C" Vital Instrument Bus inverter.

The inverter failure was due to a problem in the Slave Gating Circuit which affected the voltages at the Master Gating Circuit causing the thyristors to fire out of sequence. This caused the main DC power fuse at the input to the master thyristor section to blow. The inverter at this point could not provide enough power to the vital loads and therefore attempted a transfer. As soon as the transfer switch changed position the load was lifted from the inverter output and the slave circuit was able to provide enough power through the master output transformer to re-energize the transfer switch coil.

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APPARENT CAUSE OF OCCURRENCE: (cont'd)

The result was a continual chattering of the transfer switch as the inverter continued to attempt to pickup and drop load.

ANALYSIS OF OCCURRENCE:

The failure of the "C" Vital Instrument Bus inverter caused a false RCP trip breaker open signal in the SSPS (momentary loss of power to the contact) resulting in the reactor trip. The logic for this trip is "one out of four" when the Unit is operated above permissive P-8 (36% power). With the Unit operating at 100% power, the reactor tripped. This trip is an anticipatory trip for a pending loss of Reactor Coolant System (RCS) (AB) flow or reduced flow condition.

The P-4 interlock actuates when the reactor trip breakers open. This interlock resets the high steam flow setpoint for SI to the no-load value. This causes the High Steam Flow bistables to actuate until actual steam flow decreases to below approximately 40%. This occurs rapidly following a normal trip. However, in this instance, due to the failed inverter, the low steamline pressure bistables for Nos. 22 and 23 Steam Generators were actuated (Channel III for both Steam Generators are fed from 2C Vital Instrument Bus). Therefore, the combination of high steamline flow (greater than 40%), which is normal following a full power trip, in conjunction with an indicated low steam generator pressure on two steam generators satisfied the logic for initiation of safety injection and main steam line isolation.

The sequence of events associated with this reactor trip and SI are not unique, although, the circumstances initiating the C Vital Instrument Bus failure is unique. Two (2) other reactor trip/SI events have occurred as a result of the loss of C Vital Instrument Bus, reference LERs 311/86-007-00 and 311/85-022-00.

Equipment and systems responded properly to the "indicated" loss of RCS flow and steamline rupture except for some of the equipment powered off of "C" Vital Instrument Bus. This equipment included Nos. 23 and 25 Containment Fan Coil Units (CFCUs) and 2PR2 (Pressurizer Relief Valve).

The CFCUs are designed to mitigate the consequences of a design base Loss of Coolant Accident (LOCA) or Main Steamline Break (in Containment) by limiting the temperature rise in Containment. They are required to start and operate in slow speed upon receipt of an SI signal. However, Nos. 23 and 25 did not start since the timer switch is powered from "C" Vital Instrument Bus. Upon initiation of an SI, the SEC will trip the respective CFCU(s) and then start them in slow speed after 20 seconds. The chattering of the C Vital Instrument Bus inverter apparently prevented the timer from "timing out". The Containment Spray System is 100% redundant to the CFCUs; it was Operable during this event.

Valve 2PR2, Pressurizer Power Operated Relief Valve (PORV), failed to open automatically when the Pressurizer high pressure setpoint was

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ANALYSIS OF OCCURRENCE: (cont'd)

reached. It was manually opened as required in accordance with Emergency Operating Procedure EOP-TRIP-1. The reason it failed to open automatically is attributed to the "C" Vital Instrument Bus. The control loop is powered via the "C" Vital Instrument Bus. With this Bus inoperable, it did not receive the control signal to open. The increased RCS pressure was caused by the increased charging flow associated with the SI. The redundant Pressurizer Power Operated Relief Valve, 2PR1, was tagged due to seat leakage. The PORVs are designed to relieve pressure during all design transients. Operation of these valves minimizes the opening of the spring-loaded Pressurizer code safety valves.

This event involved no undue risk to the health or safety of the public. However, because of the automatic actuation of the Reactor

Protection System, this event is reportable in accordance with the requirements of the Code of Federal Regulations, 10CFR 50.73(a)(2)(iv). In addition, due to the Emergency Core Cooling System actuation, this report also fulfills the requirements of the ninety (90) day Special Report required by Technical Specification 3.5.2 (action b).

CORRECTIVE ACTION:

The "C" Vital Instrument Bus inverter chatter, in addition to the trip and SI, caused the sequence of events printer to "overload" due to the excessive number of relays being set and reset. The event times for SI components were subsequently verified.

Valve 2PR2 and the Nos. 23 and 25 CFCUs were tested to ensure operability. Testing included manual and automatic operation as required during plant transients and accident scenarios. Testing was successfully completed. No problems were identified.

The "C" Vital Instrument Bus Inverter has been repaired. The Unit was returned to service on June 25, 1988.

A design change has been initiated (2EC-2245) to delete the reactor trip logic which occurs when "one out of four RCP breakers open" is met. As stated in the Analysis of Occurrence section, this trip is anticipatory and is not taken credit for in the accident analysis for the station. This design change will be implemented during the upcoming fourth refueling outage pending approval by the NRC of a license change request. A similar design change for Salem Unit 1 will be implemented during its next refueling outage.

A design change is being prepared to replace the inverters with state of the art equipment.

POST SAFETY INJECTION DATA:

Initial Pressurizer Level

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POST SAFETY INJECTION DATA: (cont'd)

Final Pressurizer Level Indication Off Scale High

Initial Pressurizer Pressure 2245 psig

Final Pressurizer Pressure 2000 psig

Initial Average Reactor Coolant Temperature 569 degrees F

Final Average Reactor Coolant Temperature 545 degrees F

Refueling Water Storage Tank Temperature 82 degrees F

Duration of Safety Injection 29 minutes

/s/ J. M. Zupko, Jr.
General Manager -
Sale
Operations

MJP:pc
SORC Mtg. 88-060

ATTACHMENT # 1 TO ANO # 8807290082 PAGE: 1 of 1

PSE&G

Public Service Electric and Gas Company
P.O. Box E, Hancocks Bridge, New Jersey 08038

Salem Generating Station
July 20, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

SALEM GENERATING STATION
LICENSE NO. DPR-75
DOCKET NO. 50-311
UNIT NO. 2
LICENSEE EVENT REPORT 88-014-00

This Licensee Event Report is being submitted pursuant to the requirements of the Code of Federal Regulations 10CFR 50.73(a)(2)(iv). This report is required within thirty days of discovery.

Sincerely yours,

/s/ J. M. Zupko, Jr.
J. M. Zupko, Jr.
General Manager -
Salem Operations

MJP:pc
Distribution

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